

Research Article

Breakfast Consumption, BMI, and Physical Activity Among Undergraduates in Kelantan

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ABSTRACT

Breakfast is an important meal as it provides energy and supports overall health. However, many young adults, especially university students, tend to skip breakfast. Skipping breakfast has been linked to weight problems and lower levels of physical activity. Therefore, this study aimed to determine the association between breakfast consumption patterns with body mass index (BMI) and physical activity among undergraduate students at the USM Health Campus, Kubang Kerian, Kelantan. This cross-sectional study involved 116 undergraduates selected through convenience sampling. A self-administered questionnaire consisted of four sections: socio-demographic characteristics, anthropometric measurements, the International Physical Activity Questionnaire (IPAQ), and breakfast consumption patterns. Associations were analysed using Pearson's Chi-Square test or Fisher's Exact test, with statistical significance set at $p < 0.05$. Most respondents were female (81.0%), aged between 19 and 23 years (90.5%), with a mean age of 21.90 ± 1.40 years. Most were third-year students (32.8%), from the School of Health Sciences (PPSK) students (87.1%), and of Malay ethnicity (64.7%). More than half (58.6%) spent between RM10–15 daily on food, with a mean of $RM14.66 \pm 6.03$, and received a monthly allowance of RM500–1000, with a mean of $RM553.73 \pm 261.78$. A total of 38.8% received study loans, and 97.4% lived in campus hostels. Based on BMI classification, 11.2% were underweight, 43.1% of normal weight, 29.3% overweight, and 16.4% obese. Regarding physical activity, 45.7% reported moderate levels, while 55.2% were breakfast skippers. However, no significant association was found between breakfast consumption pattern and BMI ($p = 0.267$) or physical activity ($p = 0.279$). Although no significant associations were found, breakfast skipping remains common, highlighting the need for healthy eating promotion and broader studies on dietary pattern and lifestyle.

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1. Introduction

Overweight and obesity have become major public health concerns worldwide, affecting populations across different age groups, including young adults. Excess body weight during early adulthood may increase the risk of developing non-communicable diseases and can negatively affect long-term health outcomes (WHO, 2025). University students represent an important population for obesity prevention as this period is often associated with lifestyle transitions, including changes in dietary patterns, physical activity behaviours, and daily routines.

Body mass index (BMI) is a measure of body weight status, calculated as weight (kg) divided by height squared (m^2), and classified as underweight, normal weight, overweight, or obese (Zierle-Ghosh &

Jan, 2023). Although BMI does not directly determine body fat percentage, it is a useful screening tool for overweight and obesity in adults (CDC, 2025). According to the Clinical Practice Guidelines (CPG) for Obesity (2023), the adult BMI classification for Malaysians ranges from $<18.5 \text{ kg/m}^2$ (underweight) to $\geq 37.5 \text{ kg/m}^2$ (obese class III) (Ministry of Health Malaysia, 2023). This underscores the role of BMI as an important indicator for identifying potential long-term health risks in the population.

Among university students, BMI may be influenced by various modifiable lifestyle behaviours, including physical activity and dietary habits such as breakfast consumption. Physical activity is defined as any bodily movement produced by skeletal muscle that requires energy expenditure from skeletal muscle (WHO, 2024). Regular physical activity helps prevent and manage non-communicable diseases, supports healthy weight, and enhances overall well-being. The WHO (2020) recommends that adults aged 18–64 years engage in at least 150 minutes of moderate-intensity aerobic activity per week, 75 minutes of vigorous-intensity activity, or an equivalent combination. Despite these recommendations, evidence indicates that young adults, particularly university students, often fail to achieve sufficient levels of physical activity.

Breakfast is widely regarded as one of the most important meals of the day, usually consumed within two hours of waking up or before 10:00 a.m. It has been linked to better weight status, nutrient intake, diet quality, and overall lifestyle outcomes (Adolphus *et al.*, 2015). Breakfast consumption has also been associated with academic performance among university students (Mat Ludin *et al.*, 2016) and physical activity. Among university students, skipping breakfast was found to be associated with physical inactivity, suggesting that students with less favourable breakfast habits may also exhibit poorer physical activity behaviours (Pengpid & Peltzer, 2020).

The prevalence of overweight and obesity among undergraduates in five Malaysian public universities was 40.6% (Radzi *et al.*, 2019). University students are particularly prone to weight-related issues due to unhealthy behaviours such as skipping breakfast and engaging in low to moderate physical activity (Telleria-Aramburu & Arroyo-Izaga, 2022). Factors contributing to poor breakfast habits include financial limitations, time constraints, heavy academic workloads, and poor mood states (Adonu *et al.*, 2023). In addition, barriers to physical activity such as low energy and lack of willpower are also common (DiSerio *et al.*, 2021). Skipping breakfast has been shown to increase energy intake later in the day and promote excessive snacking, which may lead to weight gain (Moy *et al.*, 2009; Chowdhury *et al.*, 2016). These findings indicate that both breakfast consumption and physical activity are critical lifestyle factors influencing BMI in young adults.

Although overweight and obesity among Malaysian university students have been reported, evidence from undergraduate populations in the east coast region of Peninsular Malaysia, particularly Kelantan, remains limited. Differences in socioeconomic and lifestyle contexts across regions may influence dietary behaviours, physical activity patterns, and BMI outcomes among university students. Given the high prevalence of overweight and obesity among undergraduates and the influence of breakfast consumption and physical activity on BMI, further investigation in the local university context is warranted, as limited evidence exists for Malaysian undergraduates, particularly in Kelantan. Considering the potential influence of socioeconomic and lifestyle factors on breakfast consumption, physical activity, and BMI, evidence from the local undergraduate population is needed. Understanding these associations is important for developing targeted interventions at the university level. Therefore, this study aimed to examine the association between breakfast consumption patterns, BMI, and physical activity among undergraduate students at Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan. It was hypothesised that breakfast consumption patterns would be significantly associated with BMI and physical activity among undergraduate students.

2. Materials and Methods

2.1 Study Design and Location

This cross-sectional study was conducted from March to May 2024 among undergraduate students at Universiti Sains Malaysia (USM) Health Campus, Kubang Kerian, Kelantan. A self-administered questionnaire consisting of four sections was used: sociodemographic data, anthropometric measurements (height, weight, BMI), International Physical Activity Questionnaire (IPAQ), and breakfast consumption patterns. The study was conducted in three schools namely the School of Health Sciences (PPSK), School of Dental

Sciences (PPSG) and School of Medical Sciences (PPSP) involving students from diverse age groups ethnicities and academic programmes. Convenience sampling was applied as it allowed data collection in a shorter time, is cost-effective, and simpler compared with other designs (Wang & Cheng, 2020). Ethical approval was obtained from the Human Research Ethics Committee USM (USM/JEPeM/KK/24010048) and permission was granted by the Deans of USM PPSK, PPSG, and PPSP.

2.2 Study Population

Sample size was calculated based on four parameters: BMI, physical activity, breakfast consumption, and their associations. For prevalence-based outcomes (BMI, physical activity, and breakfast consumption), the sample size was calculated using the single population proportion formula with a 95% confidence level ($Z = 1.96$) and a 5% margin of error ($\Delta = 0.05$). For the association analyses, the sample size was estimated using the formula for comparing two proportions with a 95% confidence level ($\alpha = 0.05$) and 80% statistical power ($Z\beta = 0.84$). Calculations were based on previous prevalence studies including obesity (3.8%; Talib *et al.*, 2023), physical activity (5.2%; Yusoff *et al.*, 2018), breakfast skipping (6.8%; Jayaveloo *et al.*, 2021), overweight/obesity (40.6%; Radzi *et al.*, 2019), and physical inactivity (55%; Abdul Radzak *et al.*, 2020). A 20% allowance for potential dropout was added to each estimated sample size. Based on these parameters, the estimated sample size ranged from 25 to 116, and the highest estimate was selected to ensure adequacy, resulting in a final sample size of 116 students. The inclusion criteria were Malaysian undergraduate students aged 18 years and above, enrolled in PPSK, PPSG or PPSP at USM Health Campus, while exclusion criteria included students with medically diagnosed mental health issues (such as anxiety, depression or eating disorders) or chronic diseases such as diabetes, hyperlipidaemia and hypertension.

2.3 Data Collection Procedures

Data were collected at designated venues (PUMA Hall, Nurani Hall, and Murni Hall) during scheduled sessions. After obtaining written informed consent, anthropometric measurements, including weight and height, were measured twice by the researcher using a SECA 803 digital weighing scale and a SECA 206 wall-mounted stadiometer to ensure accuracy. Body mass index (BMI) was then calculated and classified according to the Clinical Practice Guidelines (CPG) for Obesity (2023) (Ministry of Health Malaysia, 2023).

Following the measurements, respondents completed a self-administered questionnaire comprising four sections. Section A collected sociodemographic data, including age, gender, ethnicity, year of study, school, food budget, allowance, sponsorship, and living arrangements. Section B documented anthropometric data. Section C assessed physical activity using the short version of the International Physical Activity Questionnaire (IPAQ) (Craig *et al.*, 2003), which categorises activity levels as high, moderate, or low based on total MET-minutes per week. Section D examined breakfast consumption patterns, adapted from Jayaveloo *et al.* (2021) and Ho (2023), covering five items: frequency, timing, expenditure, location, and company. The questionnaire primarily employed multiple-choice response options for all items, except for breakfast expenditure, which required a numerical response (RM/day). For the questions on breakfast timing and location, an "Others" option was also provided to allow respondents to specify alternative responses. Respondents were further classified as "consumers" (≥ 3 days/week) or "skippers" (< 3 days/week) in line with previous studies (Ho, 2023). A total of 116 respondents were recruited for the study.

2.4 Statistical Analysis

Data was analysed using the Statistical Package for Social Sciences (SPSS) version 27.0, with statistical significance set at $p < 0.05$ (two-tailed) at a 95% confidence level. Normality of distribution was tested using the Shapiro-Wilk test. Categorical data were presented as frequency (percentage), while numerical data were presented as mean $\pm$ SD. Descriptive statistics were used for sociodemographic characteristics, and all data were screened for accuracy, errors, outliers, and inconsistencies prior to analysis. Body mass

index (BMI) was calculated from weight (kg)/height (m²), physical activity levels were determined from total MET-minutes/week based on IPAQ, and breakfast consumption patterns were categorised as “consumers” (≥ 3 days/week) or “skippers” (< 3 days/week). Associations between breakfast consumption and BMI status, as well as physical activity levels, were analysed using Pearson’s Chi-Square test when less than 20% of cells had an expected count < 5 , or Fisher’s Exact test when more than 20% had an expected count < 5 , with significance set at $\alpha = 0.05$.

3. Results and Discussion

3.1 Socio-demographic Characteristics of Undergraduate Students at USM

A total of 116 undergraduate students participated, with most being female (81.0%) and aged 19 to 23 years (90.5%, mean 21.90 ± 1.40 years). Most were Year 3 students (32.8%) and from PPSK (87.1%). The majority were Malay (64.7%), followed by Chinese (19.8%), Indian (11.2%), and other ethnicities (4.3%). Regarding daily food budget, most students (58.6%) spent RM10 to RM15, with a mean of RM14.66 ± 6.03 . Monthly allowance averaged RM553.73 ± 261.78 , with 58.6% receiving RM500 to RM1000. Sources of income were scholarships (34.5%), loans (38.8%), or parents (26.7%). Most students stayed in campus hostels (97.4%), with only 2.6% living with their parents.

The higher proportion of female respondents (81.0%) compared to male respondents (19.0%) in this study reflects the trend of more females pursuing higher education in Malaysia, including at USM Health Campus (Mead, 2023; Saadat *et al.*, 2022). The mean age of respondents was 21.90 ± 1.40 years, with most aged 19 to 23 years, which is consistent with the expected age group of undergraduate students in Malaysian universities (Talib *et al.*, 2013). Most respondents were from PPSK (87.1%), which may be explained by the more accessible schedules of health sciences students compared with medical and dental students in PPSP and PPSG. Ethnic distribution in this study reflects the general ethnic composition of Malaysia (Lewison *et al.*, 2016).

Socioeconomic characteristics of the respondents also provide important context. More than half reported a daily food expenditure of RM10 to RM15, which is comparable to findings among undergraduates in other Malaysian universities (Jayaveloo *et al.*, 2021). This expenditure pattern aligns with the reported monthly allowance of RM500 to RM1000, illustrating how allowance levels influence students’ food budgeting (Ho, 2023). In terms of sponsorship, most respondents were financially supported through loans and scholarships, highlighting the availability of financial assistance for tertiary education in Malaysia. The finding that almost all respondents (97.4%) resided in hostels provided on USM Health Campus further reflects the university’s emphasis on accessibility to clinical training, as proximity to Hospital Pakar Universiti Sains Malaysia (HPUSM) is essential for completing required clinical attachments. Details are shown in Table 1.

Table 1. Socio-demographic characteristics among respondents (n=116)

Variables	n (%)	Mean $\pm$ S.D
Gender		
Male	22 (19.0)	
Female	94 (81.0)	
Age		21.9 $\pm$ 1.4
19-23 years	105 (90.5)	
24-28 years	11 (9.5)	
Year of Study		
Year 1	30 (25.9)	
Year 2	31 (26.7)	
Year 3	38 (32.8)	
Year 4	16 (13.8)	
Year 5	1 (0.9)	

Variables	n (%)	Mean $\pm$ S.D
School of Study		
PPSK	101 (87.1)	
PPSP	9 (7.8)	
PPSG	6 (5.2)	
Ethnicity		
Malay	75 (64.7)	
Chinese	23 (19.8)	
Indian	13 (11.2)	
Others	5 (4.3)	
Daily Budget on Foods		14.7 $\pm$ 6.0
<RM10	11 (9.5)	
RM10 - RM15	68 (58.6)	
>RM15	37 (31.9)	
Monthly Allowance		553.7 $\pm$ 261.8
<RM500	45 (38.8)	
RM500 – RM1000	68 (58.6)	
>RM1000	3 (2.6)	
Sponsorship During Study		
Parents	31 (26.7)	
Scholarship	40 (34.5)	
Loan	45 (38.8)	
Living Arrangements		
Parents / Relatives	3 (2.6)	
Hostel	113 (97.4)	

3.2 Breakfast Consumption Patterns, BMI and Physical Activity of Undergraduate Students at USM

A total of 64 respondents (55.2%) consumed breakfast 0–2 times per week, 29 respondents (25.0%) 3–5 times per week, and 23 respondents (19.8%) 6–7 times per week. Based on this classification, 44.8% were breakfast consumers and 55.2% were breakfast skippers. Most respondents (71.6%) ate breakfast between 8:00 a.m. and 10:00 a.m., 16 respondents (13.8%) before 8:00 a.m., and 17 respondents (14.7%) at other times. Regarding expenditure, 87 respondents (75.0%) spent RM2–RM5, 18 respondents (15.5%) spent less than RM2, 9 respondents (7.8%) spent RM5–RM8, and 2 respondents (1.7%) spent more than RM8, with a mean of RM3.49 $\pm$ 2.56. Most respondents consumed breakfast at home or in hostels (65.5%), followed by USM cafeterias (30.2%), other places (2.6%), and restaurants or food stalls (1.7%). The majority (73.3%) ate alone, while 26.7% ate with family or friends.

More than half of the respondents in this study were breakfast skippers (55.2%), while 44.8% were breakfast consumers. Although the respondents were health sciences programme students with expected health awareness, breakfast skipping was still common. This may be due to academic commitments, busy schedules, and limited time to prepare or consume breakfast. This finding is comparable to a study at UiTM Shah Alam, which also reported almost equal prevalence between consumers (45.5%) and skippers (54.6%) (Ramli & Appukutty, 2018). However, a higher prevalence of breakfast consumption has been reported in other studies, such as 66.3% at Universiti Tunku Abdul Rahman (UTAR) (Ho, 2022), 68.2% at the National University of Malaysia (UKM) (Jayaveloo *et al.*, 2021), and 61.8% at Penang International Dental College (Chawla *et al.*, 2019). The differences in breakfast consumption prevalence across studies may be explained by variations in study populations, including differences in university settings, academic backgrounds, and socio-demographic characteristics. For example, Jayaveloo *et al.* (2021) and Ho (2023) reported higher proportions of Chinese respondents, who have been shown to consume breakfast more consistently due to cultural emphasis on regular eating habits from a young age (Moy *et al.*, 2009). In the present study, the majority of respondents were Malay. Analysis by ethnicity showed a statistically significant association between ethnicity and breakfast consumption (Fisher's exact test, $p = 0.003$, $N =$

116). Malay respondents had a higher proportion of breakfast skippers (64.0%) than consumers (36.0%), whereas Chinese respondents had a higher proportion of consumers (78.3%) than skippers (21.7%).

Furthermore, while this study investigated specific socioeconomic indicators (daily budget, monthly allowance, and financial sponsorship), which revealed no significant associations with breakfast consumption, other unexamined factors, such as detailed lifestyle habits and academic schedules, may still play a role and warrant future investigation.

Most respondents consumed their breakfast between 8:00 a.m. and 10:00 a.m. (71.6%) and spent RM2 to RM5 per meal (75.0%), which is similar to findings by Jayaveloo *et al.* (2021). Timing of breakfast may depend on students' class schedules, while lower spending could be due to availability of affordable food options within the university area. The majority of respondents ate breakfast at their hostel or at home (65.5%). Interestingly, most consumed breakfast alone (73.3%). Details are shown in Table 2.

Table 2. Breakfast consumption patterns among respondents (n=116)

Variables	n)	(%)	Mean ± S.D
Frequency of breakfast consumption in a week			
0 – 2 times	64	(55.2)	
3 – 5 times	29	(25.0)	
6 – 7 times	23	(19.8)	
Breakfast consumption			
Breakfast consumer	52	(44.8)	
Breakfast skipper	64	(55.2)	
Time of breakfast consumption			
Before 8 a.m.	16	(13.8)	
8 a.m. to 10.00 a.m.	83	(71.6)	
Other times	17	(14.7)	
Amount of money spent on breakfast per day			3.5 ± 2.6
<RM 2	18	(15.5)	
RM2 – RM5	87	(75.0)	
RM5 – RM8	9	(7.8)	
>RM8	2	(1.7)	
Location of breakfast consumption			
Cafeterias in USM	35	(30.2)	
Restaurant / food stall	2	(1.7)	
Home / hostel	76	(65.5)	
Others	3	(2.6)	
Breakfast companion			
Family / friend	31	(26.7)	
Alone	85	(73.3)	

In terms of anthropometric measurements, results show that the respondents had a mean weight of 60.31 ± 18.26 kg, mean height of 157.7 ± 15.2 cm, and mean BMI of 23.1 ± 4.5 kg/m². Based on BMI classification, 13 respondents (11.2%) were underweight, 50 respondents (43.1%) fell under the normal range, 34 respondents (29.3%) were overweight, and 19 respondents (16.4%) were obese. Meanwhile, in terms of physical activity, results show that 23 respondents (19.8%) fell in the low category, 53 respondents (45.7%) in the moderate category, and 40 respondents (34.5%) in the high category based on IPAQ classification. The mean total MET-min/week recorded in this study is 2692.2 ± 2426.9 . Details are shown in Table 3.

In the current study, there was a high prevalence of overweight and obesity among respondents, with 29.3% of respondents were overweight and 16.4% were obese. These prevalences are relatively similar to a study conducted among undergraduate students in five public universities in Peninsular Malaysia

which found that the prevalence of overweight was 23.0% and obesity was 17.6% (Radzi *et al.*, 2019). The findings are also consistent with a study in public universities in Sarawak which reported the prevalence of overweight and obesity as 22.2% and 16.9% respectively based on Asian cut-off points (Pitil & Ghazali, 2022). Young adults, particularly higher education students, are becoming progressively overweight and obese regardless of gender (Grasdalsmoen *et al.*, 2019), most likely due to a complex interplay of changes in the food environment, physical activity, socioeconomic, environmental, and genetic factors (Chooi *et al.*, 2019). Moreover, stress and poor time management may act as barriers to weight management among university students, potentially hindering efforts to achieve or maintain a healthy body weight (Chen *et al.*, 2019). In the present study, the association between BMI classification and gender was not statistically significant. Similarly, physical activity showed no significant association with BMI categories. Furthermore, socioeconomic characteristics were examined in this study (through daily budget, monthly allowance, and financial sponsorship), revealing no significant links to breakfast consumption.

In the current study, most respondents were active (80.2%) with moderate (45.7%) and high (34.5%) physical activity levels, while only 19.8% were less active. This finding may be attributed to the active lifestyle of university students, including daily walking and movement within the campus environment. In addition, as most respondents were health sciences programme students, their health awareness and knowledge regarding the benefits of physical activity may have encouraged more active behaviours. Similar findings were reported among undergraduates in UNIMAS, a public university in Sarawak (74.1% active) and private universities in Selangor (79.6% active) (Stephen *et al.*, 2021; Tan *et al.*, 2021). In contrast, low physical activity was more common among Saudi undergraduates (62.7%) (Mahfouz *et al.*, 2020), possibly due to cultural and educational differences (Kljajević *et al.*, 2022). Students' activity levels may be influenced by motivations such as body shape, weight, and health (Alkhateeb *et al.*, 2019), while barriers include time, energy, and access to facilities (Ferreira Silva *et al.*, 2022).

Table 3. BMI and physical activity among respondents (n=116)

	n (%)	Mean ± S.D
Anthropometric measurements		
Weight (kg)		60.31 ± 18.26
Height (cm)		157.7 ± 15.2
BMI (kg/m ²)		23.1 ± 4.5
BMI:		
Underweight (<18.5)	13 (11.2)	
Normal (18.5–22.9)	50 (43.1)	
Overweight (23.0–27.4)	34 (29.3)	
Obese (>27.4)	19 (16.4)	
Physical activity		
Physical activity:		
Low	23 (19.8)	
Moderate	53 (45.7)	
High	40 (34.5)	
Total MET-min/week		2692.2 ± 2426.9

3.3 Association between Breakfast Consumption Pattern with BMI and Physical Activity among Undergraduate Students of USM

The findings showed no significant association between BMI and various breakfast consumption patterns, including frequency, timing, amount of money spent, location, and with whom breakfast was consumed ($p>0.05$) using Chi-Square or Fisher's Exact test (Table 4). Similarly, no significant association was found

between breakfast consumption pattern and physical activity level, tested using Fisher's Exact test ($p > 0.05$) (Table 5).

Table 4. Association between breakfast consumption pattern with BMI among respondents (n=116)

Variables	Underweight, n (%)	Normal, n (%)	Overweight, n (%)	Obese, n (%)	χ^2	p-value
Frequency of Breakfast Consumption						0.543 ^b
0 – 2 times	8 (61.5)	30 (60.0)	15 (44.1)	11 (57.9)		
3 – 5 times	2 (15.4)	11 (22.0)	13 (38.2)	3 (15.8)		
6 – 7 times	3 (23.1)	9 (18.0)	6 (17.6)	5 (26.3)		
Breakfast consumption						0.267 ^b
Breakfast consumer	5 (9.6)	20 (38.5)	19 (36.5)	10 (15.4)		
Breakfast skipper	8 (12.5)	30 (46.9)	15 (23.4)	11 (17.2)		
Time of breakfast consumption						0.905 ^b
Before 8 a.m.	1 (7.7)	8 (16.0)	5 (14.7)	2 (10.5)		
8 a.m. to 10.00 a.m.	9 (69.2)	36 (72.0)	25 (73.5)	13 (68.4)		
Others	3 (23.1)	6 (12.0)	4 (11.8)	4 (21.1)		
Amount of money spent on breakfast per day						0.897 ^b
<RM 2	2 (15.4)	9 (18.0)	5 (14.7)	2 (10.5)		
RM2 – RM5	11 (84.6)	36 (72.0)	26 (76.5)	14 (73.7)		
RM5 – RM8	0	5 (10.0)	2 (5.9)	2 (10.5)		
>RM8	0	0	1 (2.9)	1 (5.3)		
Location of breakfast consumption						0.950 ^b
Cafeterias in USM	6 (46.2)	17 (34.0)	4 (11.8)	8 (42.1)		
Restaurant / food stall	0	2 (4.0)	0	0		
Home / hostel	7 (53.8)	29 (58.0)	30 (88.2)	10 (56.2)		
Others	0	2 (4.0)	0	1 (5.3)		
Breakfast companion					0.676	0.879 ^a
Family / friend	3 (23.1)	15 (30.0)	9 (26.5)	4 (21.1)		
Alone	10 (76.9)	35 (70.0)	25 (73.5)	15 (78.9)		

^a Tested using Pearson's Chi-Square Test, ^b Tested using Fisher's Exact Test

Table 5. Association between breakfast consumption pattern and level of physical activity among respondents (n=116)

Variables	Low PAL, n (%)	Moderate PAL, n (%)	High PAL, n (%)	χ^2	p-value
Frequency of breakfast consumption/week				3.037	0.552 ^a
0 – 2 times	14 (60.9)	32 (60.4)	18 (45.0)		
3 – 5 times	6 (26.1)	11 (20.8)	12 (30.0)		
6 – 7 times	3 (13.0)	10 (18.9)	10 (25.0)		
Breakfast consumption				2.556	0.279 ^a
Breakfast consumer	9 (17.3)	21 (40.4)	22 (42.3)		
Breakfast skipper	14 (21.9)	32 (50.0)	18 (28.1)		
Time of breakfast consumption					0.543 ^b
Before 8 a.m.	1 (4.3)	8 (15.1)	7 (17.5)		
8 a.m. to 10.00 a.m.	17 (73.9)	38 (71.1)	28 (70.0)		
Others	5 (21.7)	7 (13.2)	5 (12.5)		
Amount of money spent on breakfast per day					0.741 ^b
<RM 2	3 (13.0)	7 (13.2)	8 (20.0)		
RM2 – RM5	17 (73.9)	40 (75.5)	30 (75.0)		

RM5 – RM8	3 (13.0)	5 (9.4)	1 (2.5)	
>RM8	0	1 (1.9)	1 (2.5)	
Location of breakfast consumption				0.853 ^b
Cafeterias in USM	6 (26.1)	18 (34.0)	11 (27.5)	
Restaurant / food stall	0	1 (1.9)	1 (2.5)	
Home / hostel	16 (69.6)	28 (70.0)	28 (70.0)	
Others	1 (4.3)	0	0	
Breakfast companion				1.360 0.507 ^a
Family / friend	4 (17.4)	16 (30.2)	11 (27.5)	
Alone	19 (82.6)	37 (69.9)	29 (72.5)	

^a Tested using Pearson's Chi-Square Test, ^b Tested using Fisher's Exact Test

The findings of this study showed that there was no significant association between breakfast consumption pattern and BMI ($p=0.267$). The percentage of breakfast consumers was the highest among overweight and obese respondents (51.4%), while breakfast skippers was the highest among normal BMI respondents (46.9%). This result was contrary to other studies which reported that breakfast skipping was strongly associated with higher BMI and risk of overweight and obesity among university students (Moy *et al.*, 2009; Mansouri *et al.*, 2020), mainly due to its effect on appetite regulation, satiety, and insulin sensitivity (Ma *et al.*, 2020). However, the findings of this study may be explained as most respondents were health sciences students who have greater awareness regarding weight management and healthy eating habits (Elsafi *et al.*, 2024). Moreover, breakfast skipping was more common among normal BMI respondents which may be due to their perception of losing weight by skipping meals, although evidence shows that eating breakfast does not significantly influence weight loss (Dhurandhar, 2014). However, it is also important to consider that breakfast skipping may reduce total daily energy intake, as breakfast contributes to overall energy consumption. When this reduction creates an overall energy deficit and physical activity levels remain constant, weight loss may occur. Irregular eating habits may instead lead to abnormal metabolism and increased cardiovascular risks (Watanabe *et al.*, 2014; Yu *et al.*, 2023).

Previous studies demonstrated that breakfast consumption among Malaysian university students remains low, largely due to environmental and economic barriers such as cost and busy student lifestyles. Jayaveloo *et al.* (2021) recommended developing practical strategies to address these barriers and encourage healthier breakfast habits among students. Moreover, lifestyle factors such as sleep quality and eating habits may also be associated with breakfast-skipping behaviour among university students (Khan *et al.*, 2024). These factors were not directly measured in this study, thereby highlighting potential areas for future research.

The findings of this study showed no significant association between breakfast consumption pattern and physical activity among undergraduate students of USM Health Campus ($p=0.279$). The present study showed that most breakfast consumers were respondents with high PAL (42.3%), while most breakfast skippers were in the moderate PAL category (50.0%). As there was no significant association, this result is similar to previous studies, where breakfast skippers were mostly in the moderate physical activity level compared to breakfast consumers (Jumi & Mohd Yusof, 2023). Energy from breakfast is reported to be significant only in the morning and may decrease after a few hours of consumption (Jumi & Mohd Yusof, 2023; Sasabe *et al.*, 2021; Zakrzewski-Fruer *et al.*, 2019), which may suggest that breakfast consumption alone may not be a strong independent predictor of overall physical activity levels. This finding should be interpreted within the context that physical activity is influenced by multiple lifestyle and environmental factors beyond breakfast habits.

Physical activity among students can be influenced by multiple factors beyond diet. Deliens *et al.* (2015) reported that university students' participation in physical activity was affected by individual, social, and environmental determinants, including limited time, academic workload, and university lifestyle pressures. Motivation levels vary widely, with some students prioritising sports or recreational activities, while others focus on study or leisure time that is largely sedentary (Alecú, Onea, & Badau, 2025). Environmental and social factors, such as access to sports facilities, weather conditions, and peer

encouragement, also play a role (Brown *et al.*, 2024). Therefore, even if students consume breakfast regularly, these other factors may have a stronger influence on their total physical activity levels. Considering these influences can help contextualise why breakfast consumption alone may not show a direct association with activity levels in this population.

3.4 Strengths, Limitations, and Future Recommendations

This study has several notable strengths. It contributes updated data on the prevalence of breakfast consumption patterns, body mass index (BMI) status, and physical activity levels among undergraduate students in Universiti Sains Malaysia. Despite the absence of significant associations, the findings provide important baseline information that may guide the development of targeted health interventions to promote healthy eating habits and active lifestyles within the university population.

However, several limitations must be acknowledged. The reliance on self-administered questionnaires may have introduced reporting bias and recall errors, particularly in recalling past physical activities. Some respondents may also have misinterpreted or rushed through questions, leading to incomplete or inaccurate responses. Additionally, the cross-sectional design prevents the establishment of causal relationships between breakfast consumption, BMI, and physical activity. Furthermore, energy intake was not assessed in this study; therefore, its potential influence on the similarity in BMI outcomes between breakfast consumers and skippers could not be determined. Other potential confounding factors, such as sleep patterns and students' stress levels, were also not assessed. These factors may influence breakfast consumption patterns, BMI, and physical activity levels, and should be considered in future studies to provide a more comprehensive understanding of these associations. Nevertheless, the findings of this study should be interpreted with caution due to potential sampling bias associated with the use of convenience sampling. The use of convenience sampling may introduce potential sampling bias, as the majority of respondents were recruited from the School of Health Sciences (PPSK) (87%). This may limit the representativeness of the sample and the generalizability of the findings to the broader university student population with different academic backgrounds.

Future research should adopt longitudinal designs, such as cohort studies, to better capture causal pathways between breakfast habits, weight status, and physical activity patterns. Employing random sampling strategies is also recommended to reduce researcher bias and enhance the representativeness of study outcomes. Expanding future work to include additional lifestyle factors such as sleep, stress, and dietary quality may further strengthen understanding of the determinants of students' health behaviours. Additionally, future studies should consider assessing potential confounding and mediating factors, particularly total energy intake, dietary patterns, meal timing, and sedentary behaviours, to provide a more comprehensive understanding of the associations between breakfast skipping, BMI, and physical activity behaviours.

4. Conclusion

In conclusion, this study showed that most undergraduates had a normal BMI, moderate physical activity levels, and a tendency to skip breakfast. However, no significant association was found between BMI or physical activity level and breakfast consumption patterns among students of Universiti Sains Malaysia, Health Campus.

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